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Nonlinear transient thermo-elastoplastic analysis of temperature-dependent FG plates using an efficient 3D meshless model

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Abstract
This paper presents a nonlinear thermo-elastoplastic bending analysis of temperature-dependent functionally graded (FG) plates exposed to a combination of mechanical and thermal loads using an efficient three-dimensional (3D) truly meshless approach based on the local radial point interpolation method (LRPIM). In this model, while using a new radial basis function (RBF), it is well shown that the quality of the LRPIM shape functions is not affected by the shape parameter. The modified rule of mixtures is employed to locally evaluate the effective temperature-dependent parameters of the functionally graded material. To describe the plastic behavior of the FG plate, the von Mises yield criterion, isotropic strain hardening, and the Prandtl-Reuss flow rule are adapted. To demonstrate the high capability and efficiency of the present method, the current results are compared with other existing numerical and analytical results, which shows an excellent agreement. The effect of significant parameters such as material gradient, ceramic volume fraction, plate thickness-to-length ratio, and boundary conditions on the nonlinear bending response of FG plates has also been investigated.

Keywords Thermo-elastoplastic analysis · Local radial point interpolation method · Functionally graded plate · Temperature-dependent material properties · Modified rule of mixtures

Mathematics Subject Classification 65M22 · 74C05 · 74K20

1 Introduction

Functionally graded materials (FGMs) are advanced composites that are made by mixing two or more materials, usually ceramic and metal, in an organized manner so that, to achieve the desired mechanical properties, the constituent volume fractions change with a specific

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